

**TRAINING INTERVENTION STUDIES AS FOUND IN THE LITERATURE ADDRESSING VARIOUS TYPES OF OCCUPATIONAL HAZARDS**

<b>A-II. Control of Health Hazards—Chemical Agents</b>						
Work Setting Operation (Ref)	Training Objective	Training Plan	Evaluation Method	Extra-Training Factors	Results	Comments
16 groups of farm workers (total of 566 people) having pesticides exposures. (Barnett, Midtling, Velasco, Romero, O'Malley, Clements, Tobin, Wollitzer, & Barbaccia, 1984)	To inform workers on pesticide use, routes of exposure, symptoms of poisoning, simple first aid, and means for minimizing exposure, and governmental rules regarding protection.	Slide show, recorded narration featuring interview with poisoned worker, plus brochures were used to convey information. Question and answer session held with audience. Presentations and material offered in Spanish to match workers' background.	Audience split into three groups: One group interviewed with set questions before presentation to establish baseline knowledge, a second interviewed at end of session to determine immediate gain, and a third interviewed one week later. Spanish used throughout.	None specially noted but references made to the fact that the county from which the workers were drawn was the first in United States to require that warning signs be posted in fields of pesticide treated crops.	Increased knowledge on pesticide hazards noted for the two groups interviewed after the session; protective regulation questions were most difficult. 84.5% of audience believed pesticides a serious hazard to agriculture workers; information needs cited on persistence of residues in field and hazards posed by chemical drift.	Information obtained in this study resulted in revisions in audio-visual presentations to address problem needs as noted. Study addresses literacy factors and accommodation to language fluency of audience.

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8 lumbermen engaged in handling timber coated with chlorophenol, a preservative having known toxic properties, with dermal contact being the principle route for exposure. (Bentley & Horstman, 1986)	To counsel workers in the need to reduce contact/exposures to chlorophenol via use of gloves/aprons, application of barrier creams, washing hands at breaks, wearing clothes offering maximum coverage, and laundering them each day.	Training intervention conducted over a 3-week period. At start-up, 1) workers interviewed/answered questionnaire on personal protection and hygiene practices, 2) exposures to chlorophenol measured via air/urine samples, and 3) a fluorescent agent was added to the chlorophenol enabling the workers to see extent of skin contact using ultra-violet lamps. Workers counseled in need to follow personal protection, hygiene practices, and view areas of their body with UV light to show effect.	Air samples were monitored throughout the 3-week period to ensure no changes in work conditions. Questionnaire and urine samples were taken at the end of the 3-week session to compare with those taken at the onset to determine apparent shifts in use of protective measures and their effect on exposure and dose levels.	Workers were encouraged during breaks to visualize their contact with the chlorophenol by using the UV illumination.	Before/after tests of chlorophenol urine metabolites showed reductions for all but one worker, the median decrease was 32% for one metabolite (tetrachlorophenol) and 5% for a second (pentachlorophenol). Greatest reduction was for those who wore clean overalls each day. UV visualization detected previously unknown sources of contamination. Post training questionnaire responses showed shift to increased skin protective measures for 9 of 11 items.	Forms of feedback (use of UV light to illuminate dermal contact areas and needs for control) that dramatize the effects of behavior actions taken can be a potent motivator for such behaviors.

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114 asbestos workers on the occasion of being recertified for undertaking such work. (Booker, Catlin, & Weiss, 1991)	Intent of 1 year refresher was to determine retention of original instruction and applicability of work practices to worksite situations encountered.	Original certification required 32 hours of instruction on legal issues, asbestos hazards, proper work practices, and use of personal protective equipment including respirators. 12 hours of this instruction was practical hands-on training.	Workers were retested on material from initial certification course by a questionnaire. Also asked how well course aided them in work area preparations, removal methods, glove bagging, decontamination, clean-up/take-down procedures, and how closely actual work conditions allowed prescribed procedures to be followed.	Not applicable	On retest, workers did better on specific work practices questions than those dealing with other issues. Most workers rated instruction better than adequate to fill job needs; some noted lack of time and contractor enforcement as complications to following prescribed measures. Trainees with most recent work experience gave higher ratings on prescribed work practices and health behaviors such as informing one's physician of asbestos work.	Study not originally designed as an evaluation effort but gave opportunity for an assessment of original training. Results lack "bottom line" indication that the certification program is paying off in terms of reduced cases of asbestos-related disease.

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209 workers from 15 auto plants whose jobs involve use of solvents. (Bosco & Wagner,1988)	To compare knowledge gains and merits of interactive video training versus lecture/video-tape instruction on hazards in handling solvents and related safe-work practices.	Workers were divided into two groups who were instructed first with one method and then with the second in counter-balanced fashion. Training for both required one whole day	Workers were given before/after achievement tests, attitude/opinion surveys to measure knowledge increase, and interest/preference for instruction. Training time and demographic factors were also analyzed.	None.	Interactive video yielded fewer errors on knowledge quiz, more high achievers, and favorable interest in and use of information. Years of education showed correlation with knowledge scores. Test time for interactive video more variable than lecture/videotape as expected.	Results indicate positive response to more active, individual forms of learning. Evaluation conducted under psuedo-lab conditions that may limit conclusions. How much information is retained from either learning method remains open.

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118 workers representing 58 employers engaged in hazardous waste site operations. (Brown & Nguyen-Scott, 1992)	To promote employee actions aimed at defining and remedying major shortcomings in hazardous waste site control efforts.	Consortium of 6 universities and a state labor group formulated 5-day training program accenting worker participation, worker/instructor co-learning, and worker empowerment. Focus on 4 modules (of 20 total) on workers' rights and responsibilities, personal protective equipment, decontamination, and emergency response training. Risk chart from worker and instructor inputs used to define problems on these subjects. Via small group meetings, decisions made on problems to be addressed, remedial actions needed, and how to effect expected progress in 3 months. Contact persons selected for follow-up progress reports.	At 3 and 12 months post-training, trainees to undergo a standard telephone interview to determine 1) how successful in following up problems originally identified, 2) what obstacles met to implementing changes, and 3) did training help in correcting problems. Added questions probed for resource materials used and for discussions with management/co-workers on health/safety issues raised in courses.	See results section.	Results based on 3-month follow-up interview with 39 workers from 39 different employers. Three priority problems identified by trainees as a group were 1) inadequate supply of air purifying respirators and self-contained breathing equipment, 2) no adequate emergency plans, and 3) inaccessible information on hazardous chemicals at the worksite. 40% of trainees indicated that the most critical problems were corrected through their efforts (prompting management, sharing course materials with co-workers, holding health and safety meetings). 32% of trainees indicated some improvement; 28% indicated no improvement.	Article gives positive and negative features of training program. Among positive are the ways for focussing on prime targets for change and that the trainees interact and learn from one another and become the change agents in the process. Follow-up interviews serve as reinforcement tool. Some limitations were that the contact person tends to be a supervisor who might give a biased view of the worksite situation (since changed in that each group member is now a contact person); plan not feasible for those who have not yet begun to work or whose jobs require moves from one site to another. A concern about the evaluation itself was the self-report method, i.e., ex-trainees may respond in ways that the course evaluators want to hear.

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Conduct of a pilot OS&H training effort in a 100-worker foundry. (Caparaz, Rice, Graumlich, Radike, & Morawetz, 1990)	To enhance worker knowledge of hazardous materials found at their workplaces, recognition of symptoms, safe handling practices, and spill control measures and to generally improve their understanding of MSDSs, Also to appreciate noise, vibration, and physical hazards at work.	Training content based on interviews with 51 workers showing gaps in identifying chemical and physical agent hazards and means for reducing exposure risk. This produced a hazard communication manual for training that reviewed sections of the MSDSs and an add-on unit on physical hazards. 16 workers served as pilot group for training; small groups (3–4 workers) with similar exposure risks were used in one 2.5 hour session. Group discussion and exercises were used to foster active learning.	Worker knowledge of exposure agents in their workplaces was tested just before and at the end of the training session, and then at a 2-week follow-up. Also workers gave feedback on receptiveness to training approach.	None elaborated beyond that noted in the needs analysis which was the basis for the training content.	Post-test results at end of training session showed trainee knowledge scores to be higher and item difficulty scores to be lower. The 2-week follow-up tests showed some drop in these knowledge scores though they were still higher than the pre-test measures. Trainees stated that training was too short and too fast. No changes in content were noted.	Decreases in test scores at 2-week follow-up suggest need for more reinforcement of knowledge gain. Question remains as to whether knowledge gain will translate into preventive actions.

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278 hazardous waste site workers, both English and Hispanic speaking, in blue collar, technical-professional, and managerial jobs. (Cole & Brown, 1996)	To promote more worker-initiated actions aimed at identifying and solving health and safety problems found at their individual waste sites.	Trainees enrolled in 3-day or 5-day worker-centered, training-for-action courses. At end of course, each trainee developed Action Plan to identify 1–3 health/safety problems at their worksite with specific steps they and employer could take at correction. 5 types of problems noted.	Approximately, 3–8 months after course, telephone interviews held with trainees to determine progress on Action Plan. Specific information sought on whether attempts made to address problems, were any corrected, and whether trainee participated in remedy.	Emphasizes how critical management support is to realizing gains from training. "Even the best training program will have only limited success if management is apathetic or resistant to changes in the worksite (pg. 741)". Recognizes training problems for non-English speakers that go beyond communication issues and workplaces that lack supportive structures for effecting worker-initiated actions.	Perceived management support enhanced attempted actions on problems (86% support vs. 67% nonsupport), and problems corrected (73% support vs. 56% nonsupport). Effect of management support on trainee participation was greatest for union and technical trainees (30% difference between support vs. non-support). Odds of Spanish speakers correcting problems were half those of English speakers.	Authors acknowledge limitations of self-reported results. Authors note that differences in the workers perceptions of what defines a problem, definitions of success, and over-reporting of success may be biased toward more positive findings.

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50 underground coal miners in one training evaluation; 283 persons engaged in coal mining work (e.g., miners, technical-maintenance, supervision) in a second. (Cole, Mallett, Haley, Berger, Lacefield, Wasielewski, Lineberry, & Wala, 1988)	To acquire skill in donning the self-contained self-rescuer emergency breathing apparatus (SCSR) to ensure its most rapid and flawless use in cases of mine fire, explosion, or gas inundation.	A first evaluation found the existing 14-step procedure for donning the equipment could not be performed proficiently for use in emergencies despite years of hands-on training and annual refresher demonstrations. Observations here yielded a revised "3+3" step plan built on 2 concepts to overcome position/sequence problems and slowed response. Modelling of new procedure and repeated opportunities for each person to observe peers were used for training with the new method.	Compare donning times for the new method vs. the old procedures, and sequential errors in performing critical tasks at completion of training session.	None elaborated.	Compared with the older procedure, the new "3+3" method reduced overall donning time by 50% and critical task time by 27%. Donning actions with the new method were also smoother than with the old, with fewer interruptions of subtasks.	Training evaluations were carried out in miner training rooms above ground that do not reflect the underground conditions of darkness, muddy/wet floors, and often dirty and battered SCSRs. Report notes that one company which trained its miners in the new procedure both above and below ground found more errors occurred underground, slowing performance time. Authors suggest need to train to high mastery levels above ground to resolve these difficulties.

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19 workers drawn from 3 plants manufacturing fiberglass reinforced products (Univ. Kansas, 1982). (See also study below by Hopkins (1984) which is a follow-up effort).	To effect worker compliance with 11 work practices and 20 housekeeping actions aimed at reducing worker exposure to styrene, a hardening agent used in plastics processing, which is a known neurotoxin (and a suspect carcinogen).	Site visits and plant mapping indicated two operational areas (spraying and roll-out) where styrene concentrations were greatest and where targeted behavioral changes could have the most effect in reducing exposure. Training included viewing videotapes of recommended actions, on-the-job practice of the prescribed behaviors, and tests to show competency and feedback on results of such tests, and praise for good performance. Each plant had 9 training meetings spread over a 4- to 5-week period, each lasting no longer than 30 minutes.	Paid observers recorded worker compliance with instructed acts at random times before, during and after the training. Over the same periods, air samples of styrene concentrations were collected as were urine samples for mandelic acid assays to establish worker exposure dose. Data collection for 3 plants included baseline and pre/post training intervals using a staggered schedule. The overall period of data collection spanned 71 weeks.	From the beginning of training through the end of post-training, the trainer gave social approval whenever workers were observed to be following the procedures as instructed; or corrected them if they weren't. Monetary incentives were offered workers for cooperating in the effort and for passing tests certifying their competencies in the procedures at the end of training.	As averaged for the 3 plants, worker actions complying with the prescribed work practices increased from 74% at baseline, to 93% at the end of training, to 96% during post-training. Conformance with housekeeping behaviors increased from 34% at baseline, to 83% at end of training, to 92% during post-training. Pre/post air concentrations of styrene showed reductions ranging from 33% to 80% for the 3 plants; for bioassays, the reductions ranged from 26% to 55%.	The results support the conclusion that the training and motivational procedures altered the behaviors in ways that had the desired effect of reducing styrene exposure. The methods used were quite elaborate, which may make voluntary adoption by other employers doubtful. Use of a respirator was the least compliant behavior. See study below by Hopkins, 1984 which examines the durability of the changes observed in this evaluation.

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6 workers from 2 plants who took part in an earlier training program (Univ. Kansas, 1982) for controlling styrene exposures in fiberglass plastic manufacturing. (Hopkins, 1984)	To assess the durability of work practices and housekeeping procedures established through an earlier training/motivational program for reducing exposures to styrene, a toxic agent used in manufacturing reinforced plastic products.	Earlier training, 2 years before, effectively altered behaviors to conform with 11 work practices and 20 housekeeping measures. No new or added training given 6 workers who were part of the original training group.	Using same observers as in the earlier effort, frequency of acts conforming to the 11 work practices and 20 housekeeping procedures were recorded for the 6 workers and compared with their baseline and post-training data from the original study. In one of two plants, comparisons made for breathing zone measures of styrene to note any changes 2 years since the last measurements.	In the intervening 2 years, management had done little to maintain the behavioral changes resulting from the original training effort. One notable exception was more insistence on use of respirators for certain tasks because of the presence of a new supervisor. An add-on feature at the end of this 2-year follow-up was to reintroduce the feedback and incentives used originally for maintenance.	Of work practices and housekeeping measures showing 90% conformance in post-training for the 6 workers, 2/3rds still occurring at this level 2 years later. Practices that worsened from previously high compliance were those requiring frequent attention and extra efforts. Feedback and incentives at end of the follow-up trial strengthened adherence to some weakened practices. Reduced styrene levels were maintained.	Increased wear of respirators noted reflecting added demands by a supervisor but worker resistance still apparent.

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89 workers from 14 hospitals whose jobs include sterilization tasks with ethylene oxide (EtO), a toxic agent regulated by an OSHA standard. (LaMontagne, Kelsey, Ryan, & Christiani, 1992)	1) To gain heightened awareness of hazards of EtO and needs for and ways for minimizing exposures; 2) identify barriers to appropriate controls and explore ways to overcome them; 3) cultivate worker participation in health/safety issues with the idea of having other positive effects.	Curriculum and training manual developed through a needs assessment based on EtO literature and current training programs, site visits to sterilizing facilities, interviews with workers, and consultations with OS&H experts. Plan included one 3- 4-hour session and a 1- 2-hour follow-up, 4–6 weeks later. Interactive techniques, small group discussions used throughout to reinforce learner-centered approach. Problem scenarios used to spark discussion and creative problem-solving. Demonstrations in sterilizing facilities to accent learning points.	Post-training questionnaires used to gauge utility of training, plus a comparison of its quality vs. 25 other types of OS&H programs funded by a State accident department in terms of the technical course content, instructional techniques, and transfer of training. Also, between first and second training session, trainees asked whether they had taken actions aimed at correcting or improving OS&H practices in their work situations.	None elaborated.	More than 84% of the trainees believed the course improved their hazard recognition and their ability to find solutions. 70% indicated that the training changed the way that they will do their jobs. The program was ranked 5th highest among the 26 assessed for merit. Positive changes were reported in the follow-up session at most sites, notably in expenditures for engineering control and personal protective equipment.	Evaluation measures are self-report and predominantly qualitative.

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35 foremen in a lead alkly production plant with significant blood/lead and urine/lead levels. (Maples, Jacoby, Johnson, Ter Haar, & Buckingham, 1982)	To promote awareness of lead (Pb) toxicity and value of specific work practices/personal hygiene measures (e.g., wash hands/face before eating, wear clean uniforms daily, proper use of respirators) to reduce exposure/intake of inorganic/organic Pb.	Group meetings held monthly of 8–9 foremen focussed on industrial hygiene of organic/inorganic Pb and its toxicity; and on the importance of specific work practices/personal hygiene, respirator fit testing plus training in effective use of such equipment to limit exposure.	Collect/analyze bimonthly blood samples and monthly urine samples before and during the course of training for a 1-year period. The blood/Pb and urine/Pb values were discussed with the groups of workers during the monthly meetings and compared with one another.	As foremen observed reduction in their own blood/Pb and urine/Pb levels, they shared information with people reporting to them.	Overall results showed a 40% drop in urine/Pb levels, a 24% drop in blood/Pb levels. Those having the higher urine/Pb (>100µq/L) and blood/Pb (>50µq/dL) levels showed the greatest reductions.	No observations were made to determine the extent of compliance with work practices. Authors believed that working with employees on small group basis allows for more tailoring of training to meet job situation. Study was a pilot effort; it was expanded to include all employees having high blood-urine Pb levels.

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Workers engaged in hazardous waste site operations or as emergency responders to toxic chemical releases. (Luskin, J., Somers, C., Wooding, J., & C. Levenstein, 1992)	1) To meet the training requirements for hazardous waste site workers (40-hour course), industrial emergency responders (24-hour course) as contained in CFR 1910.120, and the 8-hour course for refresher purposes. 2) Adopt a learner-centered program stressing empowerment in meeting the above requirements.	Small groups engaged in problem-solving exercises wherein trainees work/apply information noted in lectures. Report-back sessions used to exchange ideas, discuss issues, and share personal experiences. Mock incident planning and role-playing in accident simulation used to promote learning and equipment familiarity.	1) Ratings of course value, quality of training materials, 2) pre-post knowledge tests, attitude questionnaire on health/safety items for emergency responders, and 3) follow-up survey of 1000 trainees on effects of training at their worksites, areas of major impact, and ways to improve course.	None elaborated.	Value ratings of 40- and 24-hour courses similar (81%–88% worthwhile; 90+% rated materials good or better). Results for 8-hour class lower (59% rated worthwhile; 80% good for materials). Pre/post knowledge gain = 35.5%. Attitude responses showed 15% to 40% shifts toward more preventive actions. Follow-on survey results: 50%–60% more willing to raise safety/health issues with employers; 60+% changed work habits; 47% believed improved safety programs had prevented accidents.	Weakness of evaluation is self-report nature of data. Also the response rate to the follow-on survey was only 14%, which raises questions about the representativeness of the results. Authors point out difficulties in a learner-centered approach. Tensions arise in trying to cover topic requirements in a given time, differing needs of the trainee group, and instructors having to learn new roles as facilitators.

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<p>Union developed training program for workers at hazardous waste sites or who respond to emergency spills along with management level persons who have supervisory responsibilities for such operations. (McQuiston, Coleman, Wallerstein, Marcus, Morawetz, &amp; Ortlieb, 1994)</p>	<p>To enable trainees to become active participants in improving the safety and health conditions of their workplaces. Stress placed on providing trainees with tools, problem-solving skills, ways to access and use information resources in dealing with waste site hazard control concerns, and emergency response.</p>	<p>4–5 day learner-centered classes accented worker input, small group discussion, and problem solving exercises. Classes involved hands-on use of personal protective equipment, drum plugging/patching techniques, full dress spill simulation conducted. Trainees develop risk chart/action plan for follow-through improvements at their worksites.</p>	<p>Telephone survey 12 months after course of 481 union and 50 manager trainees from different sites. Data sought on 1) use of course materials, 2) secondary training of co-workers, 3) attempts/successes in changing program practices and equipment, 4) improvements in spill handling techniques at site, and 5) perceptions of overall course benefits.</p>	<p>To enhance follow-through actions based on course learning, it was recommended that each class include 3–4 members from a given site, one being a member of the site health and safety committee.</p>	<p>Over 70% of union and manager trainees noted use of course materials. Over 70% of union and manager trainees taught coworkers. Over 90% of union and manager trainees sought and attained changes in their site programs/equipment. Over half of trainees noted improved handling of spills since training; more than 80% felt better prepared to do so.</p>	<p>Report provides details on session content, instructional approach, categories of changes or improvements, and differentials in union/manager responses to the evaluative measures. On the latter, major difference is in improvements area where the union sees more needs for health effects training.</p>

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4,802 public employees with job titles of motor vehicle mechanics, construction laborers, electricians, traffic maintenance, plant tenders, custodians, carpenters, plumbers, print shop workers. (Miichaels, Zoloth, Bernstein, Kass, & Schrier, 1992)	To increase employee's awareness/knowledge of chemical hazards at work, enable them to understand/use material safety data sheets (MSDSs), promote employee collaboration in solving workplace health/safety problems, and provide means for discussing issues and for sharing information across city agencies and shops.	To assess job-specific hazards and employee health/safety concerns in different jobs, plan developed by joint university, union, city OS&H office staff through site visits and interviews with workers. Amounts of chemicals in use noted. Training course, modified for specific job titles, covered the HAZCOM standard: toxic chemicals, routes of entry, symptoms and health effects, control measures, and how to read MSDSs. One 6-hour and one 4-hour session was attended by 15–30 workers with similar job titles, along with foremen and supervisors. Participatory exercises used throughout to allow workers maximal input in identifying hazards of greatest concern to them, and in working through solutions/obstacles to control.	Pre/post training questionnaires used to assess changes in worker knowledge of right-to-know regulations, worker rights/employer responsibilities, and MSDS-specific understandings. A right-to-know and industrial hygiene/control scales constructed from responses to these items.	See comments column.	Post training improvement on the right-to-know scale ranged from 17% to 37%; for the industrial-hygiene-control scale, the gain ranged from 4% to 27%. As the training stressed the need for follow-up actions by workers to correct workplace OS&H shortcomings, a number of these changes were also noted and attributed to the training exercise. These included changes in 1) worksite conditions (e.g., improved ventilation systems, added supplies of protective equipment), 2) policies (e.g., no acceptance of materials w/o MSDS, posting of radiation dose measures), and 3) better coordination among departments and offices doing OS&H work.	Authors emphasize that right-to-know training will raise worker expectations on workplace changes that improve safety and health. Failure of management to respond will create worker cynicism and hostility. Best training requires tailoring to the workplaces of concern. Packaged training programs believed less effective. Program quality suffered when individual trainers were perceived as being unfamiliar with worksites, and when workers perceived management as being unresponsive to job safety/health needs raised in program discussions.

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Workers in 14 coke oven plants subject to cancer risks from coke oven emissions. (Parkinson, Bromet, Dew, Dunn, Barkman, & Wright, 1989).	To increase worker understanding of the OSHA coke oven standard and knowledge of cancer risk from such work and to foster changes in work practices aimed at minimizing exposure to coke oven emissions.	Educational program consisted of 4 modules covering union/legislative events/actions resulting in the coke oven standard; types of cancer linked to coke oven work; information on work practices (use of respirators, personal hygiene behaviors) and other control measures for reducing exposure; and the status of such control actions at the plants under study. The education program was given 4x during a 2-year period at 7 coke oven plants.	Education program offered at 7 plants, using 7 others as a control. Baseline data from workers attending each education program were obtained via questionnaire at the beginning of each educational program and by follow-up telephone interviews 1 month and 6 months later. Data collected on job health concerns, knowledge of requirements of coke oven standard, recognition of job cancer risks, and personal work practices that relate to them. Comparisons made among workers attending the program vs. non-participants vs. others in the control plants.	Union-directed program in concert with a university. Family members encouraged to attend programs. Refreshments were served and, in addition, small gifts were given to attendees (union emblems, pens, pocket flashlights).	Post-program interviews with participants indicated significant gains in knowledge of coke oven standard and adherence to safe work practices when compared with non-participants from the same plants and workers in the control plants. For those attending repeated offerings of the program, these results were even more evident, especially with regard to respirator use. Surprisingly, knowledge of the coke oven standard was low despite over 8 years of deliberation before final enactment. Non-participants felt too busy to attend.	Data on changes in work practices based on self reports, not direct observations.

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50 workers from 7 small factories where work processes involved significant use of and occupational exposure to lead (Pb). (Porru, Donato, Apostoli, Coniglio, Duca, & Alessio, 1993)	To increase worker knowledge of Pb toxicology/health risks and means for reducing exposure through proper work practices and improved personal hygiene. In addition, needs for reducing smoking and alcohol consumption which increase Pb absorption, stressed.	A 1-hour health education program undertaken in each of 7 factories where an occupational physician explained aspects of Pb absorption, health risks, and means for preventing Pb related disorders. The latter noted workplace safeguards (safe work practices/personal protective equipment use), personal hygiene as well as lifestyle factors of consequence to Pb toxicity (alcohol, tobacco intake). Booklets also issued workers to illustrate these topics.	Program was designed in 3 phases, which took place over 1 year. Phase 1 included worksite inspections to gauge plant hygiene, blood samples drawn to determine PbB levels in exposed workers, questionnaires given workers to assess their baseline knowledge of Pb poisoning and prevention. The 1-hour education session was part of this phase. Phases 2 and 3, carried out 4 and 12 months later, rechecked plant conditions, retested worker PbB levels, and repeated the questionnaire.	Authors note that during the 1-year period of the study no industrial hygiene improvements or engineering changes were made in the plants involved. Hence, any changes in PbB levels would have presumably reflected the effect of the education program.	Mean PbB levels for Phases 1, 2, and 3 showed a decreasing time trend, which was statistically significant. (The overall decrease was from 38.2 to 32.3 µg/dl). Questionnaire scores showed a similar significant time trend and overall gain of 25% for the same period. Added analyses indicated over 80% of workers showed reduction in PbB levels and 74% improved questionnaire scores.	Study did not include observations of any behavior change to ascertain the basis for the apparent drop in PbB levels. Workers reported changes in one or more behaviors, mainly increased use of protective devices and decreased use of alcohol and smoking. Authors infer that these changes could have been effected by specific knowledge gained in the Pb health education program.

TRAINING INTERVENTION STUDIES AS FOUND IN THE LITERATURE ADDRESSING VARIOUS TYPES OF OCCUPATIONAL HAZARDS

<b>A-II. Control of Health Hazards—Chemical Agents</b>						
Work Setting Operation (Ref)	Training Objective	Training Plan	Evaluation Method	Extra-Training Factors	Results	Comments
Workers in 5 manufacturing plants subject to requirements of the Hazard Communication rule. (Robins, Hugentobler, Kaminski, & Klitzman, 1990)	To furnish information to workers on hazardous materials to which they may be exposed, the hazards involved, methods for detecting exposure, and means for protection.	Plan implemented by joint management-labor committee that included train-the-trainer courses, preparation of 21 modules specific to industry, use of sessions with workers using videos, flip-charts for discussion. Plant practices varied in training time per employee (2.8 to 19 hours), group size (18 to 30), and time of session (before, beginning, during, end of workshift).	Worker reactions collected via questionnaire on usefulness of information, work practices, and use of control measures; also from interviews and feedback from union and management representatives to the joint committee. Data collected at three time points; at end of training, and at 1 year and 2 years post training. Company records of injuries and illnesses also reviewed over the 2-year time period.	Indirect post-training changes were improvements in plant health/safety control measures such as increased availability of personal protective equipment, quicker response to house-keeping problems, and substitution of safer chemicals for more hazardous ones.	Interview data found half of employees to rate program as helpful in handling hazard situations and near significant increases in safe work practices. Training delivery factors having most positive effects were 1) use of small groups, 2) brief training sessions, 3) held before or at start of shift, 4) allow more training hours. No difference found in number of injuries/illnesses after training.	Evaluation based on subjective reports. Only objective indicator was injuries/illnesses, which showed no change. This may be too soon to see any tangible benefits from the effects being reported.

**TRAINING INTERVENTION STUDIES AS FOUND IN THE LITERATURE ADDRESSING VARIOUS TYPES OF OCCUPATIONAL HAZARDS**

<b>A-II. Control of Health Hazards—Chemical Agents</b>						
Work Setting Operation (Ref)	Training Objective	Training Plan	Evaluation Method	Extra-Training Factors	Results	Comments
327 workers engaged in handling hazardous materials where they work and at treatment, storage, and disposal-type waste site facilities. (University of Michigan, 1991)	To foster safe work practices and other control measures in waste site operations such as to reduce the risk of exposure to toxic materials, and to other job health and safety hazards.	Training programs at four institutions covered information on worker rights and responsibilities, hazard awareness, identification and control, respiratory protection, personal protective equipment, instrumentation for monitoring, safe handling of toxic materials, and emergency response planning. Teaching methods varied among the 4 programs, some stressed small group discussions and/or exercises and lectures, and others stressed simulations, case studies and resource sharing. Also training time varied from 8 to 40 hours of instruction.	Mail-out questionnaires plus interviews were used to assess program results. Items dealt with helpfulness of training, perceptions of job hazardousness, changes in trainees' work practices, discussions about health concerns, and actions taken to address such concerns.	Not elaborated.	70% of trainees surveyed judged training to be helpful in hazard recognition, knowing where to get more information, or what to do about hazard situations they may face. More than 70% reported changes in their work practices since training, 90% had discussions with co-workers on what they learned in training, and 80% brought up health/safety issues with their supervisors. Over 50% desired added training on effects of toxic materials and legal rights.	Major limitations to this work are the self-reported nature of the results and the fact that the response rate was quite low (27%).

## TRAINING INTERVENTION STUDIES AS FOUND IN THE LITERATURE ADDRESSING VARIOUS TYPES OF OCCUPATIONAL HAZARDS

<b>A-II. Control of Health Hazards—Chemical Agents</b>						
Work Setting Operation (Ref)	Training Objective	Training Plan	Evaluation Method	Extra-Training Factors	Results	Comments
80 Canadian manufacturing plants, employing from 15 to 1200 workers, yielding a total population of 10,560. (Saari, Bedard, Dufort, Hryniewiecki & Theriault, 1994)	To make workers knowledgeable of a Workplace Hazardous Materials Information System (WHMIS) that required 1) labelling of chemical containers, 2) use/availability of material safety data sheets, and 3) training workers to implement relevant procedures.	Five training options utilized in 80 plants, four offered by Canadian Safety Association (ASFETM), namely: #1 = ASFETM-trained trainers who trained workers (20 plants). #2 = ASFETM-trained employees directly (23 plants). #3 = Combination of 1 & 2 (12 plants). #4 = ASFETM-trained some plant workers (11 plants). The 5th option used a different, shorter form of training focussed on materials used at plant sites (14 plants).	Interviews with employer/employee representatives; knowledge tests to sample of workers having different contacts with chemical materials (painter, welder, store-room clerk, machine operator); and worksite tour with checklist to observe quality of labelling, MSDS practices, use of personal protective equipment. A second visit to ascertain safety climate factors via observations and employee questionnaire.	Plants using the train-the-trainer option (1 & 3) had more organized OS&H activities and were better prepared for implementing the WHMIS than those opting for other approaches. Those using the direct training option (#2) exhibited little ongoing safety program activity.	Knowledge results best for plants trained with options 2 and 3. MSDSs practices better for plants using the #1 and #3 options; all plants scored low in labelling practices. The combined option (#3) was superior overall. Factors for success were number of safety programs, time spent on safety, effective use of PPE, and good house-keeping.	Direct training of workers in safety matters from outside sources may be best for companies whose safety activities are marginal; the train-the-trainer approaches may work in places where safety programs and related activities are better organized.

**TRAINING INTERVENTION STUDIES AS FOUND IN THE LITERATURE ADDRESSING VARIOUS TYPES OF OCCUPATIONAL HAZARDS**

<b>A-II. Control of Health Hazards—Chemical Agents</b>						
Work Setting Operation (Ref)	Training Objective	Training Plan	Evaluation Method	Extra-Training Factors	Results	Comments
155 mine technical personnel whose tasks include regular mine visitations and 86 active underground miners. (Vaught, Brinch, & Kellner, 1988)	To acquire skill in donning self-contained, self-rescuer (SCSR) and the mode of instruction that best facilitates the process.	Training content used "3+3" donning method that blocked 2 basic action sequences, one for isolating the lungs, the second for preparing for escape. 4 modes of instruction used: 1) computer-based training + video demonstration, 2) lecture + video demonstration, 3) step-by-step live demonstration by instructor + video of real-time simulation, 4) video demonstration + hands-on trial with instructor.	Miner subjects divided/assigned to each of the 4 instruction modes. Following the prescribed session of instruction, trainee given a test donning trial. Proficiency measures included number and nature of performance errors, time to complete certain critical acts (e.g., isolate the lungs), and the entire donning procedure.	Not applicable.	Active trainee involvement hypothesized as being the best for instruction and the hands-on treatment. Mode 4 did show more perfect sequences than the other methods and the fastest time for critical tasks. Trainees made most errors in failure to activate oxygen, donning the goggles, and adjusting straps. The hands-on method had the fewest errors for these actions. Computer-based and lecture modes showed the poorest scores on the above measures.	Authors note that the evaluation indicated only a <u>pre-practice measure of performance</u> since each trainee would be expected to improve with repeated trials. As over-learning is believed key to proficiency in SCSR donning, time-resource constraints may complicate individual hands-on instruction as the method of choice for refresher classes. Suggestions for resolution include use of the other modes for refreshers or use of substitute SCSR devices for practice outside of usual refresher class time.

TRAINING INTERVENTION STUDIES AS FOUND IN THE LITERATURE ADDRESSING VARIOUS TYPES OF OCCUPATIONAL HAZARDS

<b>A-II. Control of Health Hazards—Chemical Agents</b>						
Work Setting Operation (Ref)	Training Objective	Training Plan	Evaluation Method	Extra-Training Factors	Results	Comments
Unspecified numbers of farm workers in New Jersey (and also Nicaragua) whose tasks subject them to pesticide exposures. (Weinger & Lyons, 1992)	To increase knowledge of health effects of pesticides, symptoms of poisoning, routes of entry, ways to minimize exposure, emergencies and first aid procedures, worker rights, and problem-solving for overcoming obstacles to gaining needed health/safety improvements.	Needs assessment took account of site visits to farms to document exposure hazards and work practices. Focal- and small-group discussions used to consider content issues, best modes for conducting training (adopted Spanish because of typical Hispanic makeup of audience), and attitudes as obstacles to learning. Training plan stressed a learner-centered approach for meeting information, attitude/emotion, behavioral skills, and problem-solving objectives of training. Techniques of role-playing, demonstrations, and case studies used to dramatize issues and promote worker participation.	Evaluations reported included biological monitoring measures of exposure (cholinesterase) and increase in level of worker activism to effect changes in response to apparent needs for safety/health improvements.	Authors emphasize that training activity alone cannot resolve problems of pesticide exposure. That the education program was part of an expanded effort using the media to increase public awareness, prompting formal sanitation surveys in the fields, and meeting with state/federal agencies to establish need for new regulations for legal action.	Workers having training were found to have higher cholinesterase levels indicative of lesser exposure to pesticides. Reflecting greater worker activism, there was greater worker willingness to testify about unsanitary working conditions, to file worker complaints for alleged violations, and to request agency inspections; these resulted in citations/fines in numerous cases.	Evaluation data are subject to other factors that can influence the outcomes noted. Extra-Training Factors column indicates the need to consider education as partly responsible.